SB761
U7I5
#82-3

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

FOREST PEST MANAGEMENT

STATE & PRIVATE FORESTRY

INTERMOUNTAIN REGION

3430
R4-82-3
January 1983

AN EVALUATION OF DISEASE AND INSECT CONDITIONS IN THE NAVAJO LAKE BASIN CEDAR CITY RANGER DISTRICT, DIXIE NATIONAL FOREST

By
Borys M. Tkacz, Plant Pathologist
David G. Holland, Regional Entomologist

ACKNOWLEDGEMENT

Appreciation is extended to LaGrande Hobbs and Lisa Morgan for assistance in field and laboratory work and Mike Harris for data analysis.

INTRODUCTION

Chronic subalpine fir and Engelmann spruce mortality has been recorded in the Navajo Lake area east of Cedar City, Utah, during Forest Pest Management (FPM) aerial surveys over the past 15 years. In the past, this mortality has been attributed to western balsam bark beetle activity; however, field checks of similar mortality centers on the Wasatch and Fishlake National Forests revealed that one or more root diseases are also involved. Similar associations between bark beetles and root diseases have been found in Colorado (James and Goheen 1981), Oregon and Washington (Lane and Goheen 1979), Idaho (Hertert et al 1975), and California (Ferrell and Smith 1976).

The Navajo Lake Basin has roaded access to the south side of the lake. Two campgrounds and a lodge facility are located along the south shore. Surrounding these campgrounds are overstocked, mature stands of subalpine fir and Engelmann spruce with some scattered Douglas-fir and aspen. Pockets of tree mortality are evident from the scenic overlook above the north side of the lake on Route 14.

Both campgrounds on the lakeshore experience heavy use during the summer months. Such heavy use has resulted in considerable soil compaction and damage to understory vegetation and overstory trees. Cedar City District personnel are currently developing a Vegetation Management Plan for Navajo Lake Campground and the surrounding area. Plan objectives include rehabilitation of the campground through site-hardening, retention and perpetuation of healthy overstory trees, providing a vertical and spatial diversity of vegetation, and providing for user safety.

LIBRARY COPY
ROCKY MT. FOREST & RANGE
EXPERIMENT STATION

The chronic mortality of overstory trees in and around the campgrounds, as well as in the surrounding stands, has led to concern about the future of the affected stands. Continuing mortality will lead to increased hazard to recreationists in and around camp pads and gradual decimation of the surrounding stands, with ensuing adverse resource and visual impacts. Although the primary use for the area is developed and dispersed recreation, District personnel are prepared to treat the problem with appropriate silvicultural methods.

At the request of Rollo H. Brunson, District Ranger, and Don L. Stewart, Recreation/Lands Staff Officer, an FPM field crew conducted systematic surveys of Navajo Lake Campground and representative stands along the south shore of Navajo Lake to determine the causes and extent of tree mortality. Trees within the campground were also evaluated to determine if they presented a hazard to recreationists.

OBJECTIVES

The objectives of this evaluation are to provide management recommendations for minimizing tree losses to insects and disease on the north-facing slope of Navajo Lake Basin and reducing hazard to recreationists from defective trees in developed sites. This evaluation will provide information on stocking, basal area, and volume losses in the timber stands in the basin. Based on the survey results, we will provide a range of management alternatives and their expected effects.

SURVEY OF STANDS ON NORTH-FACING SLOPE

A. METHODS

The survey was conducted by FPM personnel on June 18-22, 1981. The area surveyed is located along the south shore of Navajo Lake (T. 38 S., R. 8 W., Sec. 7,8 and T. 38 S., R. 9 W., Sec. 12). Due to time constraints and the size of the survey area, it was divided into four units (Fig. 1). Variable radius plots (BAF 20) were established every 2.5 chains along 30-chain transects spaced 5 chains apart in each of the four units. Data on all trees were collected at every fifth plot (volume plots). At the other plots (count plots), data were collected on diseased trees with only a basal area count of other trees on the plot.

The following data were collected for each tree: species, diameter at breast height (DBH) in inches, total height in feet, condition (live, infected, or dead within last 10 years), and cause of infection or mortality. All trees greater than or equal to 5 inches DBH were recorded on the variable plots. All dead or symptomatic trees were examined for the presence of insects or diseases. Two roots on opposite sides of these trees were excavated out to 3 feet and examined for external or internal evidence of root diseases. If positive field identification could not be made, samples of stained or decayed wood were extracted and returned to the laboratory for culturing and identification. The roots and bole of each tree were examined for signs of bark beetle activity. Bark was removed on infested trees for field determination of the species of bark beetles present. The crowns of all trees were examined for signs or symptoms of other diseases, such as dwarf mistletoes and rusts. Data collected were used to calculate mean basal area, number of trees, and volume per acre by tree species, DBH class, condition, and pest.

Fixed-area plots (0.01 acre) were established at each volume plot to measure the amount of regeneration. All trees greater than 6 inches tall and less than 4.9 inches DBH were recorded.

Infection of true firs by Fomes annosus is often difficult to identify in the field since fruiting bodies are rare and staining of the root wood can be caused by other fungi. To supplement the survey results, 20 trees (10 live, 2 faders, and 8 dead) were felled, and discs 2 inches thick were removed at stump height. These discs were incubated at the laboratory, and the presence of F. annosus was determined by the appearance of imperfect fruiting bodies (Oedocephalum). Identification of bark beetle species was determined by removing 4-foot log sections from two fading and two recently killed subalpine firs, waxing the log ends, and placing the logs in rearing cages. Emerging insects were collected for 6 months.

B. RESULTS

1. Species Distribution - The stand consisted of primarily subalpine fir with lesser amounts of Engelmann spruce and Douglas-fir (Table 1). Limber pine and aspen were present in small amounts. Subalpine fir occupied the lower DBH classes (Table 2); Engelmann spruce, the mid to larger DBH classes (Table 3); and Douglas-fir, the larger DBH classes (Table 4). Subalpine fir was regenerating most successfully with 400 seedlings and 146 saplings per acre (Table 5). Douglas-fir was also regenerating fairly well, but other species were not.

2. Disease Levels - Thirteen percent of the trees, representing 15 percent of the basal area per acre (BA/A) and 17 percent of the cubic-foot volume per acre (CF/A), were infected with one or more diseases (Table 1). Six percent of the trees were killed over approximately 10 years, representing 8 percent of the BA/A and 7 percent of the CF/A (Table 1). Tree species varied in their susceptibility to the diseases found (Table 6). Dwarf mistletoe (Arceuthobium douglasii) on Douglas-fir accounted for a large portion of the infection level. Twenty-four percent of the Douglas-fir BA/A was infected with dwarf mistletoe, and 5 percent of the Douglas-fir BA/A was killed by this disease. This pathogen was also found occasionally on subalpine fir in the vicinity of infected Douglas-fir.

Armillaria mellea was found on live and dead subalpine fir, Engelmann spruce, and Douglas-fir. This fungus was found associated with dwarf mistletoe and with Fomes annosus. Fomes annosus (alone and with other agents) was found on 10 percent of the total subalpine fir BA/A. More extensive root excavation would have revealed additional infected trees. Fomes annosus was not found on any other species in the survey area.

Results of laboratory incubation of tree discs indicated that levels of Fomes annosus may be higher than those indicated by field observation alone. One quarter of the incubated tree disks yielded Fomes annosus. Two of the live trees and three of the dead trees were found to be infected. Neither of the faders yielded Fomes annosus at stump height.

Other diseases encountered during the survey were broom rusts, (Melampsorella caryophyllacearum on subalpine fir and Chrysomyxa arctostaphyli on Engelmann spruce), Fomes pinicola and other heart rots on Douglas-fir and Engelmann spruce, Polyporus tomentosus root rot of Engelmann spruce, cankers (Cenangium

singulare and Ceratocystis fimbriata) on aspen, Phellinus tremulae heart rot of aspen, Cytospora canker on subalpine fir, and dwarf mistletoe (Arceuthobium cyanocarpum) on limber pine.

3. Insects - Very few bark beetle-infested trees were found during the variable-plot survey. Bark beetles were found only on subalpine fir infected with Fomes annosus (Table 6). Field determination of beetle species using gallery patterns was difficult due to the deteriorated state of the inner bark on all the infested trees. Eight of the twenty trees sampled for Fomes annosus incubation also had evidence of bark beetle infestation. Only two of the dead trees had no evidence of bark beetles. Both of the faders had bark beetle galleries under the bark. None of the live trees were infested. The bole samples brought into the laboratory for insect-rearing yielded the following species of bark beetles: Dryocoetes confusus, Pityophthorus sp., Pityokteines minutus, and Crypturgus borealis.

SURVEY OF NAVAJO LAKE CAMPGROUND

A. METHODS

A FPM field crew examined Navajo Lake Campground on June 17 and 18, 1981, to determine causes and extent of tree mortality and to evaluate tree hazards facing recreationists. All trees within the campground, as well as those within 200 feet of facilities or camp pads, were examined for signs of disease or defect. External signs of decay include fungus fruiting bodies (conks), basal cavities, exposed roots, bole cankers, wounds, frost cracks, lightning scars, and dead tops. Tree hazard evaluation forms, developed by FPM in Region 2 (Johnson 1981), were used during the survey (Appendix). Each tree evaluated received scores for species, potential targets, and visible defect(s) present. The product of these scores was the "Risk Rating" for that tree. Trees with a medium or high risk rating were bored with an increment borer to determine amount of decayed and sound wood. Trees with a low risk rating were thumped with the blunt end of a hatchet. If a low, hollow sound was produced, the tree was also bored. The extracted cores were examined to determine the thickness of the outer shell of sound wood. If this outer shell of sound wood was thinner than that required to maintain two-thirds of original strength (Figure 2), then the tree was marked for recommended removal by painting an orange spot at the base and recording on a site map (Figure 3) and data sheets (Appendix). When the internal-decay column was too small for immediate removal, the tree was recorded for future observation. Dead trees were automatically marked and recorded for removal. All trees were also examined for evidence of insects or disease. Pests were recorded under "comments" on the forms. Pockets of dead and diseased trees were sketched in on the site map (Figure 3).

B. RESULTS

A total of 128 trees were recorded for treatment or observation (Figure 3 and Appendix). Of these, 92 were marked for recommended removal. All of the recorded trees had permanent structures, parked vehicles, or people as potential targets. Sixteen trees had no externally visible defects; 2 had small mechanical injuries; 59 had limb defects, frost cracks, lightning scars, or large wounds; and 57 were either dead or alive with exposed roots, dead tops, conks, buttrot, or basal cavities (Appendix). Fifty-five trees were rated high risk; 63, medium risk; and 10, low risk. Fifty-one of the high risk, 37 of the medium risk, and 3 of the low risk had internal decay columns large

enough to justify immediate removal. The remainder were marked for observation and should be bored again in 5 years. Nine obvious Fomes annosus infection centers were found in or near the campground (Figure 3). Douglas-fir at the southeast end of the campground were found to be infected with dwarf mistletoe.

DISCUSSION

The most frequently encountered disease in the survey area was Douglas-fir dwarf mistletoe. Infection by this parasite causes a reduction in vigor of the host tree, which predisposes it to attack by other pests, especially bark beetles (Hawksworth & Wiens 1972). Armillaria mellea occasionally killed dwarf mistletoe-infected Douglas-fir (Table 6).

Dwarf mistletoes are parasitic flowering plants which spread by forcibly ejected seeds. Seeds are dispersed in late summer to early fall for distances up to 50 feet from the host tree and adhere to the needles or twigs they strike. Germination takes place in early spring. Infection of the host takes place through tissues less than 5 years old. Penetration of the bark is followed by the development of sinkers in the host xylem. Under ideal conditions, aerial shoots are produced 2 to 5 years after infection, and flowering occurs 1 to 2 years after shoots emerge.

All size classes of Douglas-fir were infected with dwarf mistletoe. Most of the larger overstory trees were heavily infected and posed a threat to the advanced regeneration. Although dwarf mistletoes are usually host-specific, a few subalpine fir were found to be infected with dwarf mistletoe. Hawksworth and Wiens (1972) rate subalpine fir as a "rare host" for Arceuthobium douglasii. This susceptibility class indicates that 0 to 5 percent of the subalpine fir can be infected within 20 feet of an infected Douglas-fir.

Dwarf mistletoe infection levels can be effectively reduced by removal of infected overstory trees and sanitation thinning of the susceptible understory. Encouraging regeneration or planting immune species is a viable alternative where infected overstory trees need to be retained. Since killing the host tree kills the dwarf mistletoe as well, infected trees can be girdled and left standing. However, in developed sites, dead trees should be removed immediately to ensure public safety.

Survival of infected specimen trees in campgrounds can be prolonged by pruning large witches' brooms in the lower crown. This will increase tree vigor by reducing the parasite's physiological drain on its host. Trees should have at least 30-percent live crown remaining after pruning.

Armillaria mellea and Fomes annosus were the major root diseases found in the survey area. Subalpine fir, Engelmann spruce, and Douglas-fir were infected with A. mellea. This fungus survives as a saprophyte in stumps or snags and is capable of infecting trees through root contacts or by growth through the soil. A. mellea is usually a weak pathogen and normally kills trees stressed by other causes. Trees stressed by dwarf mistletoe or Fomes annosus are often additionally attacked by A. mellea. Direct control of Armillaria root rot involves stump removal and is costly. Losses can be reduced by increasing tree vigor through thinning and control of dwarf mistletoe infection. Although infection by A. mellea may not kill a vigorous tree, loss of structural stability can occur due to decay of the roots. Root rot centers in developed recreation sites cause concentrated pockets of tree mortality and increase

tree hazards. Spruce and fir typically have shallow root systems; therefore, any decay of the roots drastically reduces their wind firmness.

Fomes annosus was found on many subalpine fir during both surveys. Although all conifers can be infected with this disease, true firs are especially susceptible. This fungus spreads by airborne spores which are produced on fruiting bodies or "conks". These conks are often found in old stumps and snags or at the root collar of infected trees. Spores which land on freshly cut stumps or wounds can germinate and colonize the wood. The fungus then grows through the roots and spreads to adjacent trees by root contacts or grafts. F. annosus can survive for long periods of time in infected stumps and can infect susceptible regeneration on the site through root contacts. Infection by this fungus results in loss of vigor, decay of the butt and roots, and mortality. Infected trees are susceptible to attack by bark beetles or other diseases, such as A. mellea. Armillaria root rot and the western balsam bark beetle (Dryocoetes confusus) were killing F. annosus-infected subalpine fir in the survey area. Many subalpine fir were directly killed by F. annosus. Control of this disease is best accomplished by preventing spore infection of freshly cut stumps.

Borax (sodium tetraborate) prevents establishment of Fomes annosus in cut stumps of trees not already infected (Nelson and Li 1980). This chemical can be easily applied to stumps by using shaker-top applicators. One pound of granular Borax is sufficient to cover 50 square feet of stump surface. This control method is highly recommended in valuable areas, such as developed recreation sites. Other methods which also reduce losses due to F. annosus include timing of cutting to coincide with hot, dry weather and covering freshly cut stumps with soil or duff to promote growth of fungi antagonistic to F. annosus, preventing wounds, and encouraging regeneration of tree species less susceptible to this pathogen than subalpine fir. Our survey results indicate that Douglas-fir, Engelmann spruce, and limber pine may be more resistant to killing by this disease in the Navajo Lake Basin.

Western balsam bark beetle is commonly associated with root-diseased subalpine fir and often invades trees following infection by root diseases (Hertert et al 1975, Lane and Goheen 1979, James and Goheen 1981, and James and Stewart 1981). This bark beetle introduces pathogenic stain fungi into attacked trees which aid in killing the trees (Molnar 1965). Ceratocystis dryocoetidis, the most virulent of these stain fungi, causes cambial and inner-bark necrosis with subsequent tree mortality. Western balsam bark beetle has a 2-year life cycle, with adult beetles attacking trees in late June through August. Reducing levels of Fomes annosus infection in the stand and increasing tree vigor will reduce mortality from western balsam bark beetle.

MANAGEMENT ALTERNATIVES

The following management alternatives are available for the Navajo Lake Basin (north-facing slope) and are arranged in increasing order of effectiveness in reducing tree mortality:

1. No Action - Loss due to root disease-, insect-, and dwarf mistletoe-caused mortality will continue at the current rate of 1.6 S/A/yr., representing 35.3 CF/A/yr. This estimate does not include growth loss in living trees, due to infection. Most of the mortality will be in subalpine fir and will be clumped in discrete centers. Drought years will accelerate the rate of mortality.

2. Salvage logging - Much of the volume loss due to mortality will be salvaged; however, the mortality rate will not be reduced. Repeated entries may, in fact, accelerate root disease infection rate if residual trees are wounded during operations and fresh-cut stumps are not treated to prevent spread of the disease.

3. Selective overstory removal/sanitation thinning - Removal of dwarf mistletoe-infected Douglas-fir overstory will stop continuing infection of Douglas-fir understory. Mortality and infection due to dwarf mistletoe will be reduced. Sanitation thinning dwarf mistletoe-infected Douglas-fir regeneration will further reduce losses due to this disease. Thinning subalpine fir and Engelmann spruce will increase vigor and resistance to root disease. Stumps should be treated with Borax or duff to prevent new Fomes annosus infections. Subalpine fir should be discriminated against during thinning, since it is more susceptible to root disease than Douglas-fir or Engelmann spruce.

4. Patch cut/selective overstory removal/sanitation thinning - This alternative is similar to the preceding one, with additional cutting in root disease centers. All infected or killed trees in these centers should be cut, including those in a 60-foot buffer strip. Advance regeneration of Douglas-fir and Engelmann spruce should be retained. Freshly cut, uninfected stumps should be treated with Borax or duff to prevent Fomes annosus spore infections. The size of openings should be less than 500 feet in diameter to encourage Engelmann spruce regeneration. All overstory dwarf mistletoe-infected Douglas-fir should be removed within 60 feet of the perimeter to prevent infection of Douglas-fir regeneration. The gradual replacement of mature subalpine fir and dwarf mistletoe-infected Douglas-fir with Engelmann spruce and Douglas-fir regeneration will reduce disease-caused mortality. Encroachment of aspen and shrubs into openings may allow the root rot fungi to die out of residual stumps before conifer regeneration becomes infected.

The alternatives presented above should be evaluated by District personnel to determine which would be compatible with the management objectives for the stand. During harvesting of mature spruce, precautions should be taken to prevent spruce beetle buildup in the area. Spruce should be cut as low to the ground as possible to reduce stump height, preferably less than 1.5 feet. Complete removal or destruction of larger-diameter (> 5") logs, tops, and branches will prevent buildup of bark beetles. If removal of large-diameter slash is not possible, the slash should be scattered into areas receiving maximum sunlight, treated with chemicals, or burned.

Where a substantial spruce beetle population exists in the adjacent forest, it may be wiser to leave the logging residuals rather than remove or destroy them immediately after cutting. Since the beetles will seek host material as they emerge, suitable residuals will attract beetles and reduce mortality of standing trees. After infestation, the residuals must be removed or treated (Schmid 1977).

Management of tree cover in the campgrounds will be considerably more difficult than in the surrounding stands. The campgrounds are located in old-growth spruce-fir stands which typically are poor sites for developed recreation sites (Johnson 1981). Both species are highly susceptible to decay fungi. Decay increases with age and tree diameter (Hinds 1977). Wounding of the trees often leads to infection by decay fungi which greatly reduce the structural stability of trees. Fomes annosus root rot was found throughout

Navajo Lake Campground. This root-rotting fungus can cause direct mortality or predispose trees to attack by other pests. Subalpine fir is typically shallow-rooted; therefore, any decay of supporting lateral roots greatly reduces wind firmness and increases likelihood of tree failure.

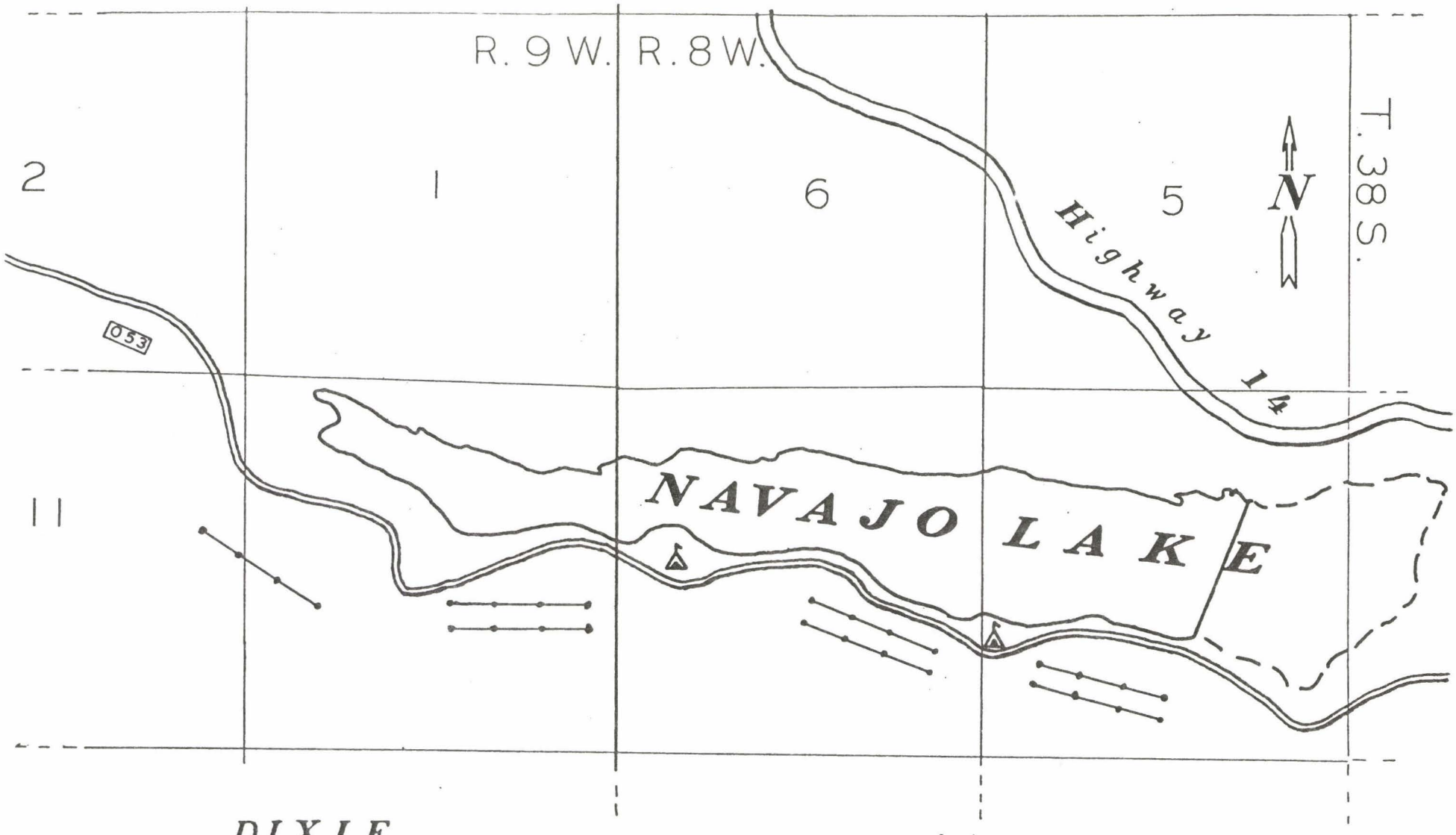
All conifer stumps created by any cutting within campgrounds should be treated with Borax or duff to prevent initiation of new disease centers. Wounding of trees should be avoided during operations. Species less susceptible to F. annosus, such as Douglas-fir, limber pine, or Engelmann spruce, should be regenerated in disease centers.

As mentioned earlier, dwarf mistletoe levels in the campground can be reduced by removal of infected overstory trees and sanitation of understory trees. Many of the large infected Douglas-fir in the campground are specimen trees which can be retained by broom pruning and underplanting with resistant species. These large trees will eventually succumb to the disease; therefore, underplanting now will hasten replacement.

Subalpine fir and aspen are very susceptible to fungal infection following wounding and should not be planted in developed recreation sites if other species are available. Planting of large site-suited stock will help increase survival of regeneration. Deterioration of ground cover and overstory cover can be reduced by hardening of routes for foot and vehicular traffic to reduce trampling and soil compaction. When paving with impervious surfacing materials, care should be taken to avoid root damage from wounding or depleting oxygen supply.

Any hazardous trees or snags should be noted during annual inspections of the campgrounds. Trees marked for observation should be bored in 5 years to evaluate extent of decay. Correction of a hazardous situation involves either cutting the defective tree or moving the potential target. The Vegetation Management Plan for a campground on the Olympic National Forest, Pacific Northwest Region (Wong 1981), recommends a novel way of reducing hazard in an old-growth stand. Defective trees smaller than 24 inches DBH will be cut as usual; however, defective trees larger than 30 inches DBH will be limbed and topped at about 30 feet to leave a wildlife snag and preserve the old-growth character of the site.

The information and recommendations presented in this report have been specifically formulated for the areas surveyed. Although this information may be applicable in other areas, conditions may be different enough to warrant separate biological evaluations. Forest Pest Management personnel are available to conduct such evaluations at the request of land managers.



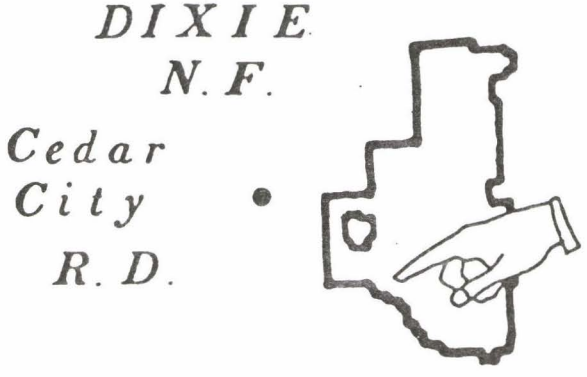


Figure 1. Location of survey transects.

transect lines with volume plot locations

campground

SCALE 1 : 24,000

TREE HAZARD EVALUATION

FOREST: DIXIE DISTRICT: CEDAR CITY SITE NAME: NAVAJO LAKE C.G.

DATE OF INSPECTION: 6-17-81 EVALUATED BY: FPM

REVIEW AND COMMENTS BY: _____ (District Ranger)

			RISK VALUE															
1/		UNIT NO.																
		MAP NO.																
		TREE NO.		49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
		D.B.H. (MINIMUM 7")		9	18	12	16	28	14	11	18	7	10	13	25	25	13	18	
TREE SPECIES	'A'	Pinyon, junipers, scrub oak	1																
		ponderosa pine, 5-needle pines, Douglas-fir	2																
		Spruce/fir, aspen, cottonwood, lodgepole pine	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POTENTIAL TARGET(S)	'B'	trails (low use), signs, etc.	1																
		temporary structures, trails (heavy use)	2																
		permanent structures, parked vehicles people	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEFECT(S) PRESENT		no visible defect	0																
		slime flux, small mechanical injury	1																
	2/ 'C'	limb defects, brooms, frost cracks, lightning scars, large mechanical wounds, forked trees, bole cankers	2	X	X	X	X		X	X		X	X	X	X			X	
		exposed roots, bole cankers (decayed), dead top, conks, punky knots, butt rot, basal cavity, leaner (unnatural), root rot, dead trees	3					X			X					X	X		X
RISK RATING	3/ Ax	HIGH (21-27)						X			X					X	X		X
	Bx	MED (10-20)		X	X	X	X		X	X		X	X	X	X			X	
	C	LOW (0-9)																	
INTERNAL INSPECTION	4/	increment borings (yr.) taken			81	81	81	81		81	81	81	81	81	81	81	81	81	
		inches sound wood			1.5	1.5	2	2.5		1	1.5	4+	6+	3	2	3	1.5	1.5	
		year next boring recommended																	
RECOMMENDED ACTION		Fell			X	X	X	X		X	X				X	X	X	X	X
		Top																	
		Prune																	
		Remove Target																	
		Observe		X					X			X	X	X					
		None																	
		Other																	
		Date Corrective Action Taken																	
		COMMENTS		F. annosus					Stain			Stain							Leaner

1/ Prepare map of hazard tree location on reverse side of form.

2/ Any tree with a risk value of 1 or 2 may require increment boring, a value of 3 requires increment boring.

3/ To determine Risk Rating (High, Medium, Low) for each tree evaluated, sum risk values (1, 2, & 3) under A, B, C (value not to exceed 3) and multiply sums A•B•C (i.e. Risk Rating cannot exceed 27).

4/ Tree Hazards Recognition and Reduction in Recreation Sites, Rocky Mtn. Tech. Rep. R2-1 (Revised 1981) See Figure 7.

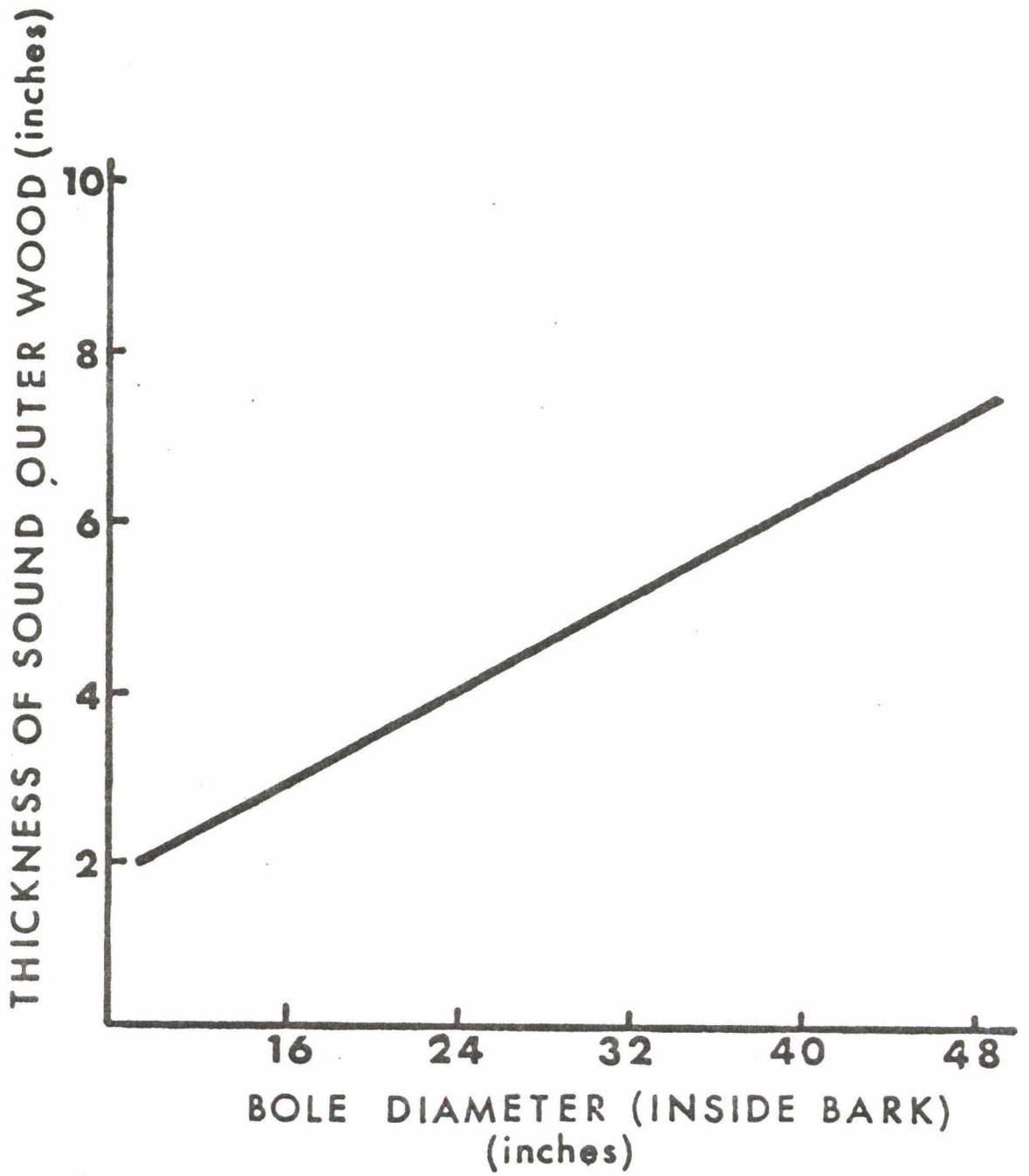


Figure 2 - Thickness of sound wood in outer shell required to maintain 66% of original strength in trees with heart rot (modified from Wagener, 1963). If the amount of sound wood exceeds that established by the line on the graph, the tree can be considered relatively safe from failure. Reprinted from Johnson (1981).

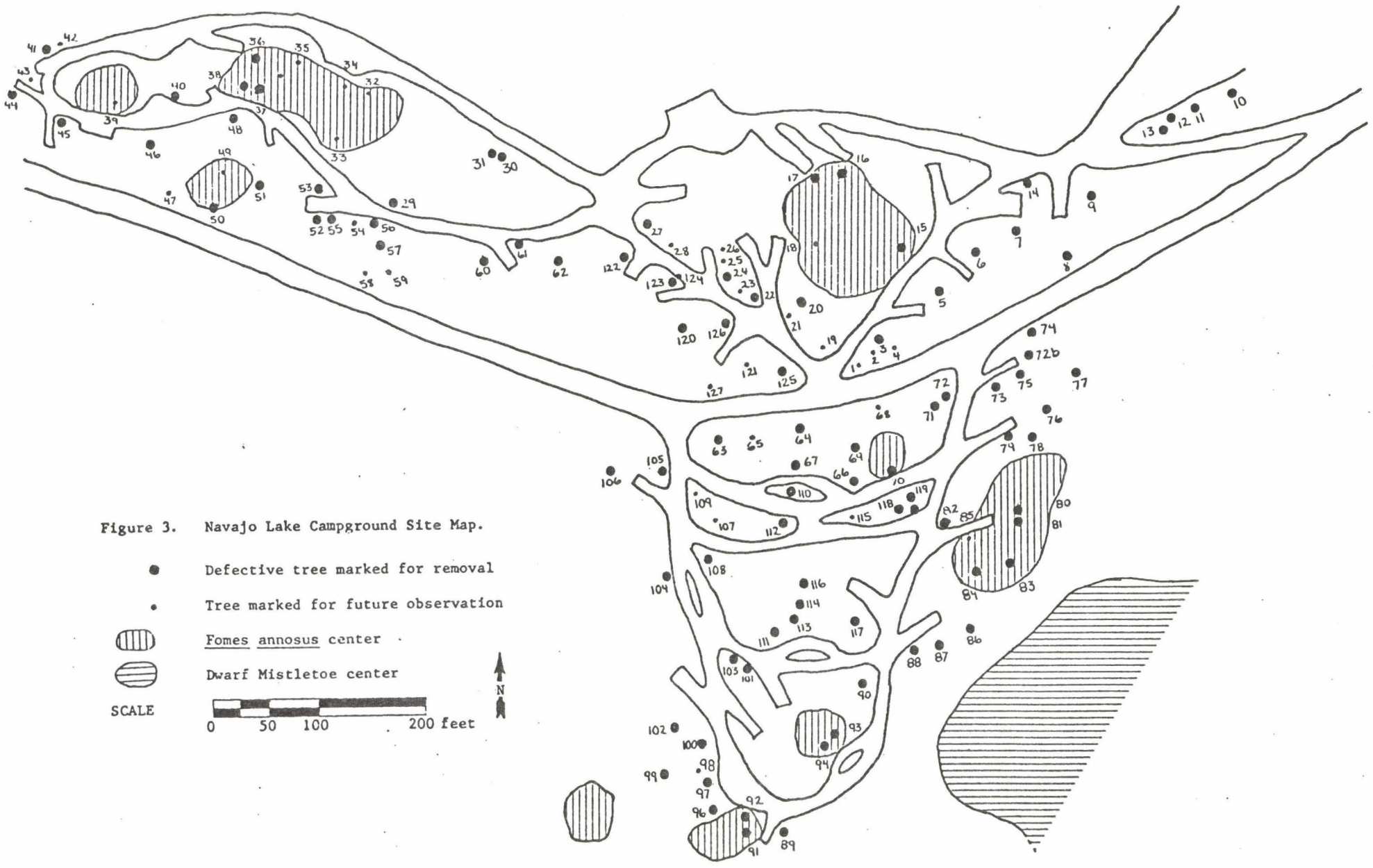


Figure 3. Navajo Lake Campground Site Map.

- ● Defective tree marked for removal
- • Tree marked for future observation
- Fomes annosus center
- Dwarf Mistletoe center

SCALE 0 50 100 200 feet

N

Table 1. Relative frequencies of trees by species and condition for the Navajo Lake survey area.

SPECIES	LIVE			INFECTED			DEAD			TOTAL OF ALL CLASSES		
	S/A[a]	BA/A[b]	CF/A[c]	S/A	BA/A	CF/A	S/A	BA/A	CF/A	S/A	BA/A	CF/A
Subalpine fir	89.3[d] (82)[d]	38.68[d] (77)[d]	823.8[d] (76)[d]	9.0 (8)	4.84 (10)	117.0 (11)	10.1 (10)	6.37 (13)	143.2 (13)	108.4[e] (41)[e]	49.89[e] (23)[e]	1084.0[e] (20)[e]
Engelmann spruce	60.9 (96)	55.38 (93)	1852.6 (95)	1.3 (3)	2.20 (4)	61.8 (4)	0.4 (1)	1.54 (3)	7.0 (1)	63.5 (24)	59.12 (27)	1960.2 (37)
Douglas-fir	40.3 (63)	56.26 (63)	1001.8 (54)	17.9 (28)	25.50 (28)	666.2 (36)	5.6 (9)	7.91 (9)	188.2 (10)	63.8 (24)	89.67 (42)	1856.2 (35)
Limber pine	1.6 (55)	5.27 (89)	125.8 (86)	1.1 (38)	0.22 (4)	4.7 (3)	0.2 (7)	0.44 (7)	15.0 (10)	2.9 (1)	5.93 (3)	145.5 (3)
Aspen	20.3 (78)	10.55 (94)	224.8 (88)	5.6 (22)	0.66 (6)	29.7 (12)	0	0	0	25.9 (10)	11.21 (5)	254.5 (5)
Total all spp.	212.4 (81)	166.14 (77)	4028.8 (76)	34.9 (13)	33.42 (15)	879.4 (17)	16.3 (6)	16.26 (8)	353.4 (7)	264.5 (100)	215.82 (100)	5300.4 (100)

a Stems per acre.

b Basal Area (sq. ft.) per acre.

c Volume (cubic feet) per acre.

d Percent of species total.

e Percent of class total.

Table 2. Mean stems per acre (S/A) and cubic foot volume per acre (CF/A) of subalpine fir by diameter class and tree condition.

Diameter Class (in.)	Height (ft.)	LIVE		INFECTED		DEAD	
		CF/A	S/A	CF/A	S/A	CF/A	S/A
6	40	208.1	50.9	9.1	2.2	9.1	2.2
8	60	173.5	20.5	26.7	3.1	10.7	1.3
10	52	57.4	5.2	22.1	2.0	22.1	2.0
12	53	55.1	3.6	8.6	0.6	51.8	3.4
14	85	170.7	5.3	13.1	0.4	19.7	0.6
16	74	92.4	2.6	11.4	0.3	17.1	0.5
18	91	44.8	0.8	0	0	6.9	0.1
20	89	21.8	0.3	20.1	0.3	0	0
26	90	0	0	5.8	0.1	0	0
28	95	0	0	0	0	5.8	0.1
Total all classes		823.8 (76.0%)	89.3 (82.4%)	117.0 (10.8%)	9.0 (8.3%)	143.2 (13.2%)	10.1 (9.3%)

Table 3. Mean stems per acre (S/A) and cubic foot volume per acre (CF/A) of Engelmann spruce by diameter class and tree condition.

Diameter Class (in.)	Height (ft.)	LIVE		INFECTED		DEAD	
		CF/A	S/A	CF/A	S/A	CF/A	S/A
8	62	91.8	10.2	0	0	0	0
10	61	177.2	13.1	0	0	5.5	0.4
12	64	183.7	9.1	17.0	0.8	11.3	0.6
14	84	477.3	13.4	0	0	7.3	0.2
16	84	356.8	7.7	0	0	14.6	0.3
18	74	146.5	2.8	0	0	0	0
20	85	215.8	2.9	14.8	0.2	0	0
22	0	0	0	0	0	0	0
24	97	105.7	0.9	8.1	0.1	0	0
26	92	74.0	0.6	7.6	0.1	0	0
28	90	23.7	0.2	7.3	0.1	0	0
30	88	0	0	7.0	0.04	7.0	.04
Total all classes		1852.6 (94.5%)	60.9 (95.5%)	61.8 (3.2%)	1.3 (2.0%)	45.8 (2.3%)	1.5 (2.4%)

Table 4. Mean stems per acre (S/A) and cubic foot volume per acre (CF/A) of Douglas-fir by diameter class and tree condition.

Diameter Class (in.)	Height (ft.)	LIVE		INFECTED		DEAD	
		CF/A	S/A	CF/A	S/A	CF/A	S/A
6	38	20.9	7.3	9.7	3.4	0	0
8	48	36.3	6.1	11.2	1.9	3.7	0.6
10	55	80.4	7.9	4.1	0.4	8.2	0.8
12	78	92.9	4.5	40.0	2.0	11.4	0.6
14	75	106.7	4.0	43.8	1.6	32.8	1.2
16	70	66.2	2.0	71.3	2.2	20.4	0.6
18	85	219.9	4.4	116.9	2.4	30.8	0.6
20	78	55.0	1.0	56.4	1.0	33.8	0.6
22	91	108.7	1.4	100.4	1.2	26.8	0.3
24	93	65.5	0.7	47.1	0.5	6.7	0.1
26	95	0	0	54.2	0.5	13.6	0.1
28	79	18.4	0.2	50.8	0.5	0	0
30	97	44.2	0.3	20.4	0.1	0	0
32	96	43.5	0.3	40.1	0.2	0	0
34	85	19.2	0.1	0	0	0	0
36	0	0	0	0	0	0	0
38	108	24.0	0.1	0	0	0	0
Total all classes		1001.8 (54.0%)	40.3 (63.1%)	666.2 (35.9%)	17.9 (28.1%)	188.2 (10.1%)	5.6 (8.8%)

Table 5. Relative frequency (stems per acre) of regeneration by species for the Navajo Lake survey area.

Species	Seedlings[a]	Saplings[b]
Subalpine fir	400.0 (56%)	146.4 (57%)
Engelmann spruce	32.1 (5%)	7.1 (3%)
Douglas-fir	253.6 (35%)	82.1 (32%)
Limber pine	32.1 (4%)	14.3 (5%)
Aspen	0 (0%)	7.1 (3%)
Total all spp.	717.8 (100%)	257.0 (100%)

a All trees without measurable DBH (<0.5")

b All trees 0.5"-4.9" DBH

Table 6. Basal area per acre (sq. ft.) of infected (I) and dead (D) trees by species and causal agent.

	Subalpine fir		Engelmann spruce		Douglas-fir		Limber pine		Aspen		Total all spp.	
	I	D	I	D	I	D	I	D	I	D	I	D
Fomes annosus	1.32 (3)[a]	2.64 (5)									1.32 (0.6)	2.64 (1)
Armillaria mellea	0.66 (1)	2.86 (6)	0.66 (1)	1.10 (2)	2.42 (3)	1.32 (1)					3.74 (2)	5.28 (2)
Dwarf mistletoe	0.22 (0.4)				21.32 (24)	4.40 (5)		0.22 (4)			21.54 (10)	4.62 (2)
Fomes pinicola					0.22 (0.3)	0.66 (0.7)					0.22 (0.1)	0.66 (0.3)
Broom rust	0.88 (2)		0.22 (0.4)								1.10 (0.5)	
Fomes annosus and bark beetles	0.44 (0.9)	0.44 (0.9)									0.44 (0.2	0.44 (0.2)
Fomes annosus and Armillaria mellea		0.22 (0.4)										0.22 (0.1)
Armillaria mellea and dwarf mistletoe						0.22 (0.3)						0.22 (0.1)
Fomes pinicola and dwarf mistletoe						0.66 (0.7)						0.66 (0.3)
Other heart rots			0.22 (0.4)		0.22 (0.3)				0.44 (4)		0.88 (0.4)	
Other root and butt rots			0.66 (1)	0.44 (0.7)	0.66 (0.7)						1.32 (0.6)	0.44 (0.2)
Cankers	0.44 (0.9)								0.22 (2)		0.66 (0.3)	
Other and unknown agents	0.88 (2)	0.22 (0.4)	0.44 (0.7)		0.66 (0.7)	0.22 (0.3)	0.22 (4)	0.22 (4)			2.20 (1)	0.66 (0.3)

a % of total species BA/A

LITERATURE CITED

Ferrell, G. T. and R. S. Smith, Jr. 1976. Indicators of Fomes annosus root decay and bark beetle susceptibility in sapling white fir. For. Sci. 22(3):365-369.

Hawksworth, F. G. and D. Wiens. 1972. Biology and Classification of Dwarf Mistletoes (Arceuthobium). U.S. Dep. Agric. Ag. Handbook No. 401. 234 p.

Hertert, H. D., D. L. Miller and A. D. Partridge. 1975. Interaction of bark beetle (Coleoptera:Scolytidae) and root rot pathogens in grand fir in northern Idaho. Can. Entomol. 107(8):899-904.

Hinds, T. E. 1977. Heart rots of Engelmann spruce and subalpine fir in the central Rocky Mountains. USDA Forest Service, Forest Insect and Disease Leaflet No. 150. 8 p.

James, R. L. and D. J. Goheen. 1981. Conifer mortality associated with root disease and insects in Colorado. Plant Disease 65(6):506-507.

James, R. L. and C. A. Stewart. 1981. Root Disease Survey on the Nezperce National Forest, Idaho. USDA Forest Service, Northern Region, Forest Pest Management Report No. 81-6. 12 p.

Johnson, D. W. 1981. Tree hazards: Recognition and reduction in recreation sites. USDA Forest Service, Rocky Mountain Region, Forest Pest Management, Technical Report R-2-1. 17 p.

Lane, B. B. and D. J. Goheen. 1979. Incidence of root disease in bark beetle-infested eastern Oregon and Washington true firs. Plant Disease Reporter 63(4):262-266.

Molnar, A. C. 1965. Pathogenic fungi associated with a bark beetle on alpine fir. Can. J. Botany 43:563-570.

Nelson, E. E. and C. Y. Li. 1980. Preliminary test of two stump surface protectants against Fomes annosus. USDA Forest Service Research Note PNW-363. 6 p.

Schmid, J. M. 1977. Guidelines for minimizing spruce beetle populations in logging residuals. USDA Forest Service Research Paper. RM-185. 8 p.

Wagener, W. W. 1963. Judging hazard from native trees in California recreation areas: A guide for professional foresters. USDA Forest Service Research Paper, PSW-P1. 29 p.

Wong, S. P. 1981. Willaby Campground - Vegetative Management Plan. USDA Forest Service, Pacific Northwest Region, Olympic National Forest, 41 p.

APPENDIX

(Tree Hazard Forms for Navajo Lake Campground)

TREE HAZARD EVALUATION

FOREST: Dixie DISTRICT: Cedar City SITE NAME: Navajo Lake C.G.

DATE OF INSPECTION: 6-17-81 EVALUATED BY: FPM

REVIEW AND COMMENTS BY: _____ (District Ranger)

			RISK VALUE															
1/		UNIT NO.																
		MAP NO.																
		TREE NO.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		D.B.H. (MINIMUM 7")		21	19	18	11	32	32	23	25	23	28	15	34		29	16	37
TREE SPECIES	'A'	Pinyon, junipers, scrub oak	1																
		ponderosa pine, 5-needle pines, Douglas fir	2																
		Spruce/fir, aspen, cottonwood, lodgepole pine	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POTENTIAL TARGET(S)	'B'	trails (low use), signs, etc	1																
		temporary structures, trails (heavy use)	2																
		permanent structures, parked vehicles people	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEFECT(S) PRESENT	2/ 'C'	no visible defect	0	X		X													
		slime flux, small mechanical injury	1				X												
		limb defects, brooms, frost cracks, lightning scars, large mechanical wounds, forked trees, bole cankers	2																
		exposed roots, bole cankers (decayed), dead top, conks, punky knots, butt rot, basal cavity, leaner (unnatural), root rot, dead trees	3		X			X	X	X	X	X	X	X	X	X	X	X	X
RISK RATING	3/ Ax	HIGH (21-27)						X	X	X	X	X	X	X	X	X	X	X	X
	Bx	MED (10-20)			X														
	C	LOW (0-9)		X		X	X												
INTERNAL INSPECTION		increment borings (yr.) taken		81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
	4/	inches sound wood			6+	2	6+	1	1	1	2.25	1.5	3.5	3/4	3/4		1		5
		year next boring recommended																	
RECOMMENDED ACTION		Fell				X		X	X	X	X	X	X	X	X	X	X	X	
		Top																	
		Prune																	
		Remove Target																	
		Observe		X	X		X												X
		None																	
		Other																	
		Date Corrective Action Taken																	
		COMMENTS						Fomes pini	Brown Rot	Butt Rot	Leaning toward road	Leaner				Fomes Annosus		Dead	

1/ Prepare map of hazard tree location on reverse side of form.

2/ Any tree with a risk value of 1 or 2 may require increment boring, a value of 3 requires increment boring.

3/ To determine Risk Rating (High, Medium, Low) for each tree evaluated, sum risk values (1, 2, & 3) under A, B, C (value not to exceed 3) and multiply sums A•B•C (i.e. Risk Rating cannot exceed 27).

4/ Tree Hazards Recognition and Reduction in Recreation Sites, Rocky Mtn. Tech. Rep. R2-1 (Revised 1981) See Figure 7.

TREE HAZARD EVALUATION

FOREST: DIXIE DISTRICT: CEDAR CITY SITE NAME: NAVAJO LAKE C.G.

DATE OF INSPECTION: 6-17-81 EVALUATED BY: FPM

REVIEW AND COMMENTS BY: _____ (District Ranger)

			RISK VALUE															
1/		UNIT NO.																
		MAP NO.																
		TREE NO.		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
		D.B.H. (MINIMUM 7")		16	16	15	12	14	10		24	9	11	12	17	23	27	13	13
TREE SPECIES	'A'	Pinyon, junipers, scrub oak	1																
		ponderosa pine, 5-needle pines, Douglas fir	2																
		Spruce/fir, aspen, cottonwood, lodgepole pine	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POTENTIAL TARGET(S)	'B'	trails (low use), signs, etc	1																
		temporary structures, trails (heavy use)	2																
		permanent structures, parked vehicles people	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEFECT(S) PRESENT	2/ 'C'	no visible defect	0							X									
		slime flux, small mechanical injury	1																
		limb defects, brooms, frost cracks, lightning scars, large mechanical wounds, forked trees, bole cankers	2	X	X	X			X			X	X	X	X	X			X
		exposed roots, bole cankers (decayed), dead top, conks, punky knots, butt rot, basal cavity, leaner (unnatural), root rot, dead trees	3				X	X			X						X	X	
RISK RATING	3/ Ax	HIGH (21-27)					X	X			X						X	X	
	Bx	MED (10-20)		X	X	X			X			X	X	X	X	X			X
	C	LOW (0-9)								X									
INTERNAL INSPECTION	4/	increment borings (yr.) taken		81	81	81	81	81	81		81	81	81	81	81	81	81		81
		inches sound wood		5+	6+	3.5	.5	3.5	1.5		2.5	2	3	1.5	2.5	2.5	3		6+
		year next boring recommended																	
RECOMMENDED ACTION		Fell					X		X		X			X		X	X	X	
		Top																	
		Prune																	
		Remove Target																	
		Observe		X	X	X		X		X		X	X		X				X
		None																	
		Other																	
		Date Corrective Action Taken																	
		COMMENTS		Leaner - Rot	Stain in Wood		Crooked, Forked	Spike-top, Leaner		Stain		DECAY	DECAY		Stain in Wood		Forked below dbh	Forked below dbh	Stain in Wood

1/ Prepare map of hazard tree location on reverse side of form.

2/ Any tree with a risk value of 1 or 2 may require increment boring, a value of 3 requires increment boring.

3/ To determine Risk Rating (High, Medium, Low) for each tree evaluated, sum risk values (1, 2, & 3) under A, B, C (value not to exceed 3) and multiply sums A×B×C (i.e. Risk Rating cannot exceed 27).

4/ Tree Hazards Recognition and Reduction in Recreation Sites, Rocky Mtn. Tech. Rep. R2-1 (Revised 1981) See Figure 7.

TREE HAZARD EVALUATION

FOREST: Dixie DISTRICT: Cedar City SITE NAME: Navajo Lake C.G.

DATE OF INSPECTION: 6-17-81 EVALUATED BY: FPM

REVIEW AND COMMENTS BY: _____ (District Ranger)

			RISK VALUE																
1/		UNIT NO.																	
		MAP NO.																	
		TREE NO.		33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
		D.B.H. (MINIMUM 7")		18	22	18	18	16	6	9	11	15	13	14	24	13	9	8	15
TREE SPECIES	'A'	Pinyon, junipers, scrub oak	1																
		ponderosa pine, 5-needle pines, Douglas fir	2																
		Spruce/fir, aspen, cottonwood, lodgepole pine	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POTENTIAL TARGET(S)	'B'	trails (low use), signs, etc	1																
		temporary structures, trails (heavy use)	2																
		permanent structures, parked vehicles, people	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEFECT(S) PRESENT	2/ 'C'	no visible defect	0																
		slime flux, small mechanical injury	1																
		limb defects, brooms, frost cracks, lightning scars, large mechanical wounds, forked trees, bole cankers	2		X	X	X	X		X		X	X			X		X	
		exposed roots, bole cankers (decayed), dead top, conks, punky knots, butt rot, basal cavity, leaner (unnatural), root rot, dead trees	3	X					X		X			X	X		X		X
RISK RATING	3/ Ax	HIGH (21-27)		X					X		X			X	X		X		X
	Bx	MED (10-20)			X	X	X	X		X		X	X			X		X	
	C	LOW (0-9)																	
INTERNAL INSPECTION	4/	increment borings (yr.) taken			81	81	81	81	81		81	81		81	81	81	81	81	81
		inches sound wood			4.5	6+	1.5	2.5	1		1	.5		6+	3	1	1	3+	1.5
		year next boring recommended																	
RECOMMENDED ACTION		Fell					X	X	X		X	X			X	X	X		X
		Top																	
		Prune																	
		Remove Target																	
		Observe		X	X	X				X			X	X				X	
		None																	
		Other																	
		Date Corrective Action Taken																	
		COMMENTS		STAIN, Forked Top, Leaner	Thin Crown	Stain - Poor crown				E. annosus	Fork							Stain	

1/ Prepare map of hazard tree location on reverse side of form

2/ Any tree with a risk value of 1 or 2 may require increment boring, a value of 3 requires increment boring

3/ To determine Risk Rating (High, Medium, Low) for each tree evaluated, sum risk values (1, 2, & 3) under A, B, C (value not to exceed 3) and multiply sums A•B•C (i.e. Risk Rating cannot exceed 27).

4/ Tree Hazards Recognition and Reduction in Recreation Sites, Rocky Mtn. Tech. Rep. R2-1 (Revised 1981) See Figure 7.

TREE HAZARD EVALUATION

FOREST: DIXIE DISTRICT: CEDAR CITY SITE NAME: NAVAJO LAKE C.G.

DATE OF INSPECTION: 6-17-81 EVALUATED BY: FPM

REVIEW AND COMMENTS BY: _____ (District Ranger)

			RISK VALUE																
1/		UNIT NO.																	
		MAP NO.																	
		TREE NO.		65	66	67	68	69	70	71	72	726	73	74	75	76	77	78	79
		D.B.H. (MINIMUM 7")		11	10	12	23	9	6	16	18	34	10	30	7	17	38	29	17
TREE SPECIES	'A'	Pinyon, junipers, scrub oak	1																
		ponderosa pine, 5-needle pines, Douglas fir	2																
		Spruce/fir, aspen, cottonwood, lodgepole pine	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POTENTIAL TARGET(S)	'B'	trails (low use), signs, etc	1																
		temporary structures, trails (heavy use)	2																
		permanent structures, parked vehicles, people	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEFECT(S) PRESENT	2/ 'C'	no visible defect	0																
		slime flux, small mechanical injury	1																
		limb defects, brooms, frost cracks, lightning scars, large mechanical wounds, forked trees, bole cankers	2	X	X	X					X	X							
		exposed roots, bole cankers (decayed), dead top, conks, punky knots, butt rot, basal cavity, leaner (unnatural), root rot, dead trees	3				X	X	X	X			X	X	X	X	X	X	X
RISK RATING	3/ Ax	HIGH (21-27)					X	X	X	X			X	X	X	X	X	X	X
	Bx	MED (10-20)		X	X	X					X	X							
	C	LOW (0-9)																	
INTERNAL INSPECTION		increment borings (yr.) taken		81	81	81	81	81		81	81	81		81	81	81	81	81	81
	4/	inches sound wood		2.5	1.5	.25	7	1		1.5	1.5	4		4	1	.5	2	.5	1.5
		year next boring recommended																	
RECOMMENDED ACTION		Fell			X	X		X	X	X	X	X	X	X	X	X	X	X	X
		Top																	
		Prune																	
		Remove Target																	
		Observe		X			X												
		None																	
		Other																	
		Date Corrective Action Taken																	
		COMMENTS					Spike Top		Dead aspen				Dead						

1/ Prepare map of hazard tree location on reverse side of form.

2/ Any tree with a risk value of 1 or 2 may require increment boring, a value of 3 requires increment boring.

3/ To determine Risk Rating (High, Medium, Low) for each tree evaluated, sum risk values (1, 2, & 3) under A, B, C (value not to exceed 3) and multiply sums A•B•C (i.e. Risk Rating cannot exceed 27).

4/ Tree Hazards: Recognition and Reduction in Recreation Sites, Rocky Mtn. Tech. Rep. R2-1 (Revised 1981) See Figure 7.

TREE HAZARD EVALUATION

FOREST: DIXIE DISTRICT: CEDAR CITY SITE NAME: NAVAJO LAKE C.G

DATE OF INSPECTION: 6-18-81 EVALUATED BY: FPM

REVIEW AND COMMENTS BY: _____ (District Ranger)

			RISK VALUE	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
1/		UNIT NO.																	
		MAP NO.																	
		TREE NO.		80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
		D.B.H. (MINIMUM 7")		9	10	32	26	23	11	12	37	22	14	16	15	17	13	10	13
TREE SPECIES	'A'	Pinyon, junipers, scrub oak	1																
		ponderosa pine, 5-needle pines, Douglas fir	2				X	X											
		Spruce/fir, aspen, cottonwood, lodgepole pine	3	X	X	X			X	X	X	X	X	X	X	X	X	X	X
POTENTIAL TARGET(S)	'B'	trails (low use), signs, etc.	1																
		temporary structures, trails (heavy use)	2																
		permanent structures, parked vehicles, people	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEFECT(S) PRESENT	2/ 'C'	no visible defect	0																
		slime flux, small mechanical injury	1																X
		limb defects, brooms, frost cracks, lightning scars, large mechanical wounds, forked trees, bole cankers	2			X			X							X			
		exposed roots, bole cankers (decayed), dead top, conks, punky knots, butt rot, basal cavity, leaner (unnatural), root rot, dead trees	3	X	X		X	X		X	X	X	X	X	X		X	X	
RISK RATING	3/ Ax	HIGH (21-27)		X	X					X	X	X	X	X	X		X	X	
	Bx	MED (10-20)				X	X	X	X							X			
	C	LOW (0-9)																	X
INTERNAL INSPECTION	4/	increment borings (yr.) taken				81					81	81	81	81		81	81	81	81
		inches sound wood				3					4	1	2.5	1.5		.75	.5	.5	1.5
		year next boring recommended																	
RECOMMENDED ACTION		Fell		X	X	X	X	X		X	X	X	X	X	X	X	X	X	
		Top																	
		Prune																	
		Remove Target																	
		Observe							X										X
		None																	
		Other																	
		Date Corrective Action Taken																	
		COMMENTS		DEAD	DEAD		DEAD	Dead	F. annosus Stain	Dead					Dead aspen	Dead aspen	F. annosus	F. annosus	

1/ Prepare map of hazard tree location on reverse side of form.

2/ Any tree with a risk value of 1 or 2 may require increment boring, a value of 3 requires increment boring.

3/ To determine Risk Rating (High, Medium, Low) for each tree evaluated, sum risk values (1, 2, & 3) under A, B, C (value not to exceed 3) and multiply sums A•B•C (i.e. Risk Rating cannot exceed 27).

4/ Tree Hazards: Recognition and Reduction in Recreation Sites, Rocky Mtn. Tech. Rep. R2-1 (Revised 1981) See Figure 7.

TREE HAZARD EVALUATION

FOREST: DIXIE DISTRICT: CEDAR CITY SITE NAME: NAVAJO LAKE C.G.

DATE OF INSPECTION: 6-18-81 EVALUATED BY: FPM

REVIEW AND COMMENTS BY: _____ (District Ranger)

			RISK VALUE															
1/		UNIT NO.																
		MAP NO.																
		TREE NO.		96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
		D.B.H. (MINIMUM 7")		19	20	10	29	25	8	28	8	9	19	33	9	15	16	16	15
TREE SPECIES	'A'	Pinyon, junipers, scrub oak	1																
		ponderosa pine, 5-needle pines, Douglas fir	2																
		Spruce/fir, aspen, cottonwood, lodgepole pine	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POTENTIAL TARGET(S)	'B'	trails (low use), signs, etc	1																
		temporary structures, trails (heavy use)	2																
		permanent structures, parked vehicles, people	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEFECT(S) PRESENT	2/ 'C'	no visible defect	0											X	X			X	
		slime flux, small mechanical injury	1																
		limb defects, brooms, frost cracks, lightning scars, large mechanical wounds, forked trees, bole cankers	2	X	X	X	X	X	X	X	X		X			X	X		X
		exposed roots, bole cankers (decayed), dead top, conks, punky knots, butt rot, basal cavity, leaner (unnatural), root rot, dead trees	3									X							
RISK RATING	3/ Ax	HIGH (21-27)										X							
	Bx	MED (10-20)		X	X	X	X	X	X	X	X		X			X	X		X
	C	LOW (0-9)												X	X			X	
INTERNAL INSPECTION	4/	increment borings (yr.) taken		81	81	81	81	81	81	81	81		81	81		81	81	81	81
		inches sound wood		1	1	3	2.5	1	.5	1.75	.5		.5	3.5		1.5	5	1.5	1.75
		year next boring recommended																	
RECOMMENDED ACTION		Fell		X	X		X	X	X	X	X	X	X	X		X		X	X
		Top																	
		Prune																	
		Remove Target																	
		Observe				X									X		X		
		None																	
		Other																	
		Date Corrective Action Taken																	
		COMMENTS																	

1/ Prepare map of hazard tree location on reverse side of form.

2/ Any tree with a risk value of 1 or 2 may require increment boring, a value of 3 requires increment boring.

3/ To determine Risk Rating (High, Medium, Low) for each tree evaluated, sum risk values (1, 2, & 3) under A, B, C (value not to exceed 3) and multiply sums A*B*C (i.e. Risk Rating cannot exceed 27).

4/ Tree Hazards Recognition and Reduction in Recreation Sites, Rocky Mtn. Tech. Rep. R2-1 (Revised 1981) See Figure 7.

TREE HAZARD EVALUATION

FOREST: DIXIE DISTRICT: CEDAR CITY SITE NAME: NAVAJO LAKE C.G.

DATE OF INSPECTION: 6-18-81 EVALUATED BY: FPM

REVIEW AND COMMENTS BY: _____ (District Ranger)

			RISK VALUE															
1/		UNIT NO.																
		MAP NO.																
		TREE NO.		112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
		D.B.H. (MINIMUM 7")		12	8	12	16	16	12	4	15	6	7	19	21	14	15	17	18
TREE SPECIES	'A'	Pinyon, junipers, scrub oak	1																
		ponderosa pine, 5-needle pines, Douglas fir	2																
		Spruce/fir, aspen, cottonwood, lodgepole pine	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
POTENTIAL TARGET(S)	'B'	trails (low use), signs, etc.	1																
		temporary structures, trails (heavy use)	2																
		permanent structures, parked vehicles, people	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DEFECT(S) PRESENT		no visible defect	0										X						
		slime flux, small mechanical injury	1																
	2/ 'C'	limb defects, brooms, frost cracks, lightning scars, large mechanical wounds, forked trees, bole cankers	2	X		X	X	X	X						X	X	X	X	X
		exposed roots, bole cankers (decayed), dead top, conks, punky knots, butt rot, basal cavity, leaner (unnatural), root rot, dead trees	3		X					X	X	X		X					
RISK RATING	3/ Ax	HIGH (21-27)			X					X	X	X		X					
	Bx	MED (10-20)		X		X	X	X	X						X	X	X	X	X
	C	LOW (0-9)											X						
INTERNAL INSPECTION		increment borings (yr.) taken		81	81	81	81	81	81	81				81	81	81	81	81	81
	4/	inches sound wood		2.5	1	1.75	4	1	1	1				3	2	3.5	1	1.5	3
		year next boring recommended																	
RECOMMENDED ACTION		Fell		X	X	X		X	X	X	X	X		X	X		X	X	
		Top																	
		Prune																	
		Remove Target																	
		Observe					X						X			X			X
		None																	
		Other																	
		Date Corrective Action Taken																	
		COMMENTS			aspen					aspen	aspen	aspen							

1/ Prepare map of hazard tree location on reverse side of form.

2/ Any tree with a risk value of 1 or 2 may require increment boring, a value of 3 requires increment boring.

3/ To determine Risk Rating (High, Medium, Low) for each tree evaluated, sum risk values (1, 2, & 3) under A, B, C (value not to exceed 3) and multiply sums A×B×C (i.e. Risk Rating cannot exceed 27).

4/ Tree Hazards Recognition and Reduction in Recreation Sites, Rocky Mtn. Tech. Rep. R2-1 (Revised 1981) See Figure 7.